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Concurrent Quantitative Laser-Induced Incandescence and SMPS Measurements of EGR Effects on Particulate Emissions from a TDI Diesel Engine

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ABSTRACT

A comparison of scanning mobility particle sizer (SMPS) and laser-induced incandescence (LII) measurements of diesel particulate matter (PM) was performed. The results reveal the significance of the aggregate nature of diesel PM on interpretation of size and volume fraction measurements obtained with an SMPS, and the accuracy of primary particle size measurements by LII. Volume fraction calculations based on the mobility diameter measured by the SMPS substantially over-predict the space-filling volume fraction of the PM. Correction algorithms for the SMPS measurements, to account for the fractal nature of the aggregate morphology, result in a substantial reduction in the reported volume. The behavior of the particulate volume fraction, mean and standard deviation of the mobility diameter, and primary particle size are studied as a function of the EGR for a range of steady-state engine speeds and loads for a turbocharged direct-injection diesel engine. Both the SMPS and LII techniques demonstrate good repeatability and consistency with each other. Increasing the EGR results in a sharp rise in the volume fraction of particulates for all engine speeds and loads. At all speed and load conditions the primary particle size decreases with increasing EGR.